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EXAMINER	
CHOI, HAN S	

ART UNIT	PAPER NUMBER
2853	

DATE MAILED: 03/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/773,200	SILVERBROOK, KIA	
	Examiner	Art Unit	
	Han S. Choi	2853	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/16/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means," "said," and "comprises" should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

2. The abstract of the disclosure is objected to because the abstract contains the word "comprises" on line 1. Correction is required. See MPEP § 608.01(b).

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. Claims 1-54 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-40, and 43-54 of copending Application No. 10/773185 (Pub. No. US 2004/0155935) in view of Silverbrook (US Pat. 5,841,452).

Referring to claims 1 and 19 of the pending application, claims 1 combined with 2 and 4, 19 combined with 20 and 22, and 38 combined with 2 and 4 of the copending application contain the limitations of the stated claims 1 and 19 of the pending application except for the limitation of generating a gas bubble substantially symmetrically about an axis extending normal to the plane of the aperture. The remaining stated claims of the copending application contain the remaining limitations of the claims of the pending application.

Silverbrook ('452) teaches in Figs. 17 and 18 generating a gas bubble [116] substantially symmetrically about an axis extending normal to the plane of the aperture.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Silverbrook ('452) with the printhead of the copending application for the purpose of expelling an ink drop [108] through the channel [489] and onto a medium such as paper [200] in [Col. 10, Lines 8-10].

This is a provisional obviousness-type double patenting rejection.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 2, 3, 8, 13, 19, 20, 21, 27, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452).

Ims teaches an ink jet printhead [10] in [Col. 4, Line 48] shown in Fig. 1. and a printer system in [Col. 4, Lines 7-9]. Ims teaches a plurality of nozzles, each nozzle having a nozzle aperture in [Col. 8, Lines 6-9]. Ims teaches a bubble forming chamber corresponding to each of the nozzles respectively in [Col. 8, Lines 7-9]. Ims teaches at least one heater element disposed in each of the bubble forming chambers respectively and in thermal contact with a bubble forming liquid in [Col. 8, Lines 10-11 and Lines 24-25]. Ims teaches heating the heater element above the boiling point of the bubble forming liquid forms a gas bubble that ejects a drop of ejectable liquid from the nozzle in [Col. 5, Lines 39-50]. Ims does not teach the heater element having a serpentine form configured to generate the gas bubble substantially symmetrically about an axis extending normal to the plane of the aperture. Ims does not teach the axis extending through the center of the aperture. Ims does not teach the bubble forming chamber

having a circular cross section and the heater element extending between two electrodes spaced from each other by a gap, wherein the heater element has a second gap diametrically opposed to the gap between the electrodes. Ims does not teach the heater element configured such that an actuation energy of less than 500 nanojoules is required to heat the heater element sufficiently to form a bubble to cause the ejection of a drop and a structure incorporating nozzles formed by chemical vapor deposition (CVD).

Silverbrook teaches the heater element [120] to have a serpentine form in [Col. 6, Lines 48-51] shown in Fig. 10. Another variant is shown in Fig. 13. Silverbrook teaches in Figs. 17 and 18 generating a gas bubble [116] substantially symmetrically about an axis extending normal to the plane of the aperture. Silverbrook teaches an axis extending through the center of the aperture in [Col. 8, Lines 44-45] shown in Fig. 13 (the nozzle opening [445] is annular with an ink drop [446] shown exiting, which an axis can be drawn through the center of the aperture). Silverbrook teaches the heater element [440] extending between two adjacent electrodes [442] spaced from each other by a gap, wherein the heater element [440] has a second gap [444] diametrically opposed to the gap between the electrodes shown in Fig. 13. Silverbrook teaches that typically 200 nanojoules is required to eject a drop by heating the heater element in [Col. 18, Lines 15-18]. Silverbrook teaches a thick chemical vapor deposition (CVD) glass over coat [142] which forms the nozzle region in [Col. 9, Lines 57-58] shown in Fig. 12.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Silverbrook with the printhead of Ims for the purpose of ensuring that high temperatures are reached while maintaining heater resistance and minimizing overall size in [Col. 6, Lines 48-50], expelling an ink drop [108] through the channel [489] and onto a medium such as paper [200] in [Col. 10, Lines 8-10], producing annular ink vapor bubbles that exerts near equal pressure to all sides of the ink drop [446] in [Col. 8, Lines 48-52], maintaining print speed while reducing power dissipation, and to provide mechanical strength to resist the shock of exploding or collapsing vapor bubbles and to provide protection against the external environment in [Col. 8, Lines 22-25].

7. Claims 4 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Abe et al. (US Pat. 4,914,562).

Ims in view of Silverbrook disclose the basic elements of the claimed invention except for a serpentine shaped heater element as a double omega shape wherein the first omega shape extends between two adjacent electrodes spaced from each other by a gap, and a second omega shape is inverted relative to the first and extending between a second gap in the first omega shape, the second gap in the first omega being positioned diametrically opposite the gap between the electrodes.

Abe et al. teaches the stated double omega shaped heater element in Fig. 17b.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the heater element of Abe et al. to the printhead of Ims in view of Silverbrook for the purpose of allowing collapsing air bubbles and associated concentrated shock waves to pass through the heating element.

8. Claims 5 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Dunn (US Pat. 4,982,199).

Ims in view of Silverbrook disclose the basic elements of the claimed invention except for the bubble forming liquid and the ejectable liquid being a common body of liquid.

Dunn teaches the bubble forming liquid and the ejectable liquid common to each other in [Col. 2, Lines 31-38] (the bubble is created from the same ink as the ink that is ejected).

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Dunn with the printhead of Ims in view of Silverbrook for the purpose of heating the same ink with a heater to create a bubble to cause the ejection of ink.

9. Claims 6, 7, 11, 18, 23, 25, 26, 30, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat.

5,841,452) as applied to claims 1 and 19 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Silverbrook disclose the basic elements of the claimed invention except for a page-width printhead configuration, the heater element in the form of a cantilever beam, the heater element having two opposite sides and configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element, supporting the bubble forming liquid in thermal contact with each heater element and ejectable liquid adjacent each nozzle, and the heater element substantially covered by a conformal protective coating, all sides of the coating being seamless.

Kubby teaches the printhead extending across the entire width of the sheet. Kubby teaches the heater element in the form of a suspended or cantilever beam [18] in [Col. 3, Lines 53-55]. Kubby teaches the heater element [20a and 20b] causing a gas bubble to be formed on both sides of the heater element [20a or 20b] in [Col. 4, Lines 59-63]. Kubby teaches a configuration to support the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle in [Col. 3, Lines 13-24] shown in Fig. 2. Kubby teaches a heater element [20a or 20b] that is substantially covered by a protective coating substantially to all sides, which are seamless in [Col. 4, Lines 32-50] shown in Fig. 4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the elements taught by Kubby to the printhead of Ims in view of Silverbrook for the purpose of placing an image on a sheet in a single pass, exposing both sides of the heater for vaporizing liquid ink, ejecting a

sufficient amount of ink from the ejector, properly heating the ink, and protecting the heater.

10. Claims 9 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Silverbrook (US Pat. 5,856,836).

Ims in view of Silverbrook ('452) discloses the basic elements of the claimed invention except for the printhead configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied to heat the heater element to cause ejection of an ink drop is less than the energy required to heat a volume of an ejectable liquid equal to the volume of the ink drop, from an ambient temperature to the boiling point.

Silverbrook ('836) teaches in [Col. 4, Lines 59-65] comprising a thermally activated liquid ink printing head being characterized by the energy required to eject a drop of ink being less than the energy required to raise the temperature of the received supply of ink of a volume equal to the volume of said ink drop above the ambient ink temperature to below ejection temperature. Ejection temperature is referred to in Claims 1 and 19 as the temperature above boiling point. Therefore, "below ejection temperature" would include the boiling point.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Silverbrook ('836) with the printhead of Ims in view of Silverbrook ('452) for the purpose of providing a higher

nozzle density per row, a manufacturing process for the printhead with low production costs, and to dissipate the full amount of the active power in the printed ink itself.

11. Claims 10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Feinn et al. (US Pat. 6,543,879).

Ims in view of Silverbrook discloses the basic elements of the claimed invention except for a nozzle density greater than 10000 nozzles/cm^2.

Feinn et al. teaches in [Col. 2, Lines 1-14] a nozzle packing density of at least 100 nozzles/mm^2, which is equal to 10000 nozzles/cm^2 when converted to square centimeters.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the nozzle density of Feinn et al. to the printhead of Ims in view of Silverbrook for the purpose of accommodating higher printing resolutions and to improve the printhead drop generation rate in [Col. 1, Lines 57-61].

12. Claims 14 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Kashino et al. (US Pat. 5,534,898).

Ims in view of Silverbrook discloses the basic elements of the claimed invention except for a nozzle plate of the printhead having a thickness of less than 10 microns.

Kashino et al. teaches a thickness of an orifice plate in the order of several microns in [Col. 6, Lines 34-41].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the thickness of the Kashino et al. nozzle plate to the Ims in view of Silverbrook printhead for the purpose of obtaining adequate values of the velocity of the discharged ink droplets, amount of ink droplet and refilling frequency, and in consideration of the distance between the thermal energy generating element and the discharge port.

13. Claims 12 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Keil et al. (US Pat. 6,447,104).

Ims in view of Silverbrook discloses the basic elements of the claimed invention except for the gas bubble collapsing to a collapse point spaced from the heater element.

Keil et al. teaches a bubble collapse occurring at a location well spaced from the heat transducer [34] in [Col. 4, Lines 48-56] shown in Figs. 3-5.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Keil et al. with the printhead of Ims in view of Silverbrook for the purpose of extending the life of the heat transducer [34].

14. Claims 15 and 34 rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Komuro (US Pat. 4,965,594).

Ims in view of Silverbrook discloses the basic elements of the claimed invention except for a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

Komuro teaches heating resistors [11A, 21, and 31] of a first, second, and third layer formed on different respective layers and a plurality of nozzles [2] having chambers [4] with heaters [11A, 21, and 31] disposed within in [Cols. 3 and 4, Lines 25-68 and 1-34] shown in Figs. 1-4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the stated structure of Komuro with the printhead of Ims in view of Silverbrook for the purpose of keeping discharge speed and frequency characteristics in a stable manner.

15. Claims 16 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Chan (US Pat. 5,710,070).

Ims in view of Silverbrook disclose the basic elements of the claimed invention except for a heater element formed of solid material of which more than 90% of which,

by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

Chan teaches a thermal inkjet printhead comprising a resistive layer composed of titanium nitride, which forms a resistor and a contact metal barrier layer in [Col. 2, Lines 10-14]. Titanium has an atomic number less than 50 on the periodic table.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the titanium nitride resistor to the printhead of Ims in view of Silverbrook for the purpose of having resistors that are more reliable, especially at higher temperatures and less complicated to manufacture.

16. Claims 17 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) as applied to claims 1 and 19 above, and further in view of Pan et al. (US Pat. 4,931,813).

Ims in view of Silverbrook discloses the basic elements of the claimed invention except for the heater element configured to a mass of less than 10 nanograms.

Pan et al. discloses the heater element including a solid that is heated to form a bubble vapor to cause ejection of an ink drop, but does not explicitly teach the solid having a mass less than 10 nanograms. It would have been obvious at the time the invention was made to a person having ordinary skill in the art at the time the invention was made to apply at least 10 nanograms of the solid material to the heating element of Ims in view of Silverbrook to cause an ejection of an ink drop since it has been held that

discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ (CCPA 1980.)

17. Claim 38, 39, 40, 41, 44, and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191).

Ims teaches an ink jet printhead [10] in [Col. 4, Line 48] shown in Fig. 1. and a printer system in [Col. 4, Lines 7-9]. Ims teaches a plurality of nozzles, each nozzle having a nozzle aperture in [Col. 8, Lines 6-9]. Ims teaches a bubble forming chamber corresponding to each of the nozzles respectively in [Col. 8, Lines 7-9]. Ims teaches at least one heater element disposed in each of the bubble forming chambers respectively and in thermal contact with a bubble forming liquid in [Col. 8, Lines 10-11 and Lines 24-25]. Ims teaches heating the heater element above the boiling point of the bubble forming liquid forms a gas bubble that ejects a drop of ejectable liquid from the nozzle in [Col. 5, Lines 39-50]. Ims does not teach the heater element having a serpentine form configured to generate the gas bubble substantially symmetrically about an axis extending normal to the plane of the aperture. Ims does not teach supplying the nozzle with a replacement volume of the ejectable liquid equivalent to the ejected drop. Ims does not teach the axis extending through the center of the aperture. Ims does not teach the heater element extending between the electrodes mounted on opposite sides of the bubble forming chamber, wherein the bubble forming chamber has a circular cross section and the heater element extends between two adjacent electrodes spaced

from each other by a gap, wherein the heater element has a second gap diametrically opposed to the gap between the electrodes. Ims does not teach the heater element configured such that an actuation energy of less than 500 nanojoules is required to heat the heater element sufficiently to form a bubble to cause the ejection of a drop and a structure incorporating nozzles formed by chemical vapor deposition (CVD).

Silverbrook teaches the heater element [120] to have a serpentine form in [Col. 6, Lines 48-51] shown in Fig. 10. Another variant is shown in Fig. 13. Silverbrook teaches in Figs. 17 and 18 generating a gas bubble [116] substantially symmetrically about an axis extending normal to the plane of the aperture. Silverbrook teaches an axis extending through the center of the aperture in [Col. 8, Lines 44-45] shown in Fig. 13 (the nozzle opening [445] is annular with an ink drop [446] shown exiting, which an axis can be drawn through the center of the aperture). Silverbrook teaches the heater element [440] extending between the electrodes [442 and 444] mounted on opposite sides of the bubble forming chamber [447] in Fig. 13. Silverbrook teaches the heater element [440] extending between two adjacent electrodes [442] spaced from each other by a gap, wherein the heater element [440] has a second gap [444] diametrically opposed to the gap between the electrodes shown in Fig. 13. Silverbrook teaches that typically 200 nanojoules is required to eject a drop by heating the heater element in [Col. 18, Lines 15-18]. Silverbrook teaches a thick chemical vapor deposition (CVD) glass over coat [142] which forms the nozzle region in [Col. 9, Lines 57-58] shown in Fig. 12.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Silverbrook with the printhead of Ims for the purpose of ensuring that high temperatures are reached while maintaining heater resistance and minimizing overall size in [Col. 6, Lines 48-50], expelling an ink drop [108] through the channel [489] and onto a medium such as paper [200] in [Col. 10, Lines 8-10], producing annular ink vapor bubbles that exerts near equal pressure to all sides of the ink drop [446] in [Col. 8, Lines 48-52], maintaining print speed while reducing power dissipation, and to provide mechanical strength to resist the shock of exploding or collapsing vapor bubbles and to provide protection against the external environment in [Col. 8, Lines 22-25].

Fukuchi et al. teaches replacing an amount equal in volume to the ink that was ejected from the nozzles in [Col. 1, Lines 35-38].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Fukuchi et al. with the modified printhead of Ims for the purpose of preventing ink degeneration in the pressure chamber in [Col. 3, Lines 51-58].

18. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Abe et al. (US Pat. 4,914,562).

Ims in view of Silverbrook and Fukuchi et al. disclose the basic elements of the claimed invention except for a serpentine shaped heater element as a double omega shape wherein the first omega shape extends between two adjacent electrodes spaced from each other by a gap, and a second omega shape is inverted relative to the first and extending between a second gap in the first omega shape, the second gap in the first omega being positioned diametrically opposite the gap between the electrodes.

Abe et al. teaches the stated double omega shaped heater element in Fig. 17b.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the heater element of Abe et al. to the printhead of Ims in view of Silverbrook and Fukuchi et al. for the purpose of allowing collapsing air bubbles and associated concentrated shock waves to pass through the heating element.

19. Claims 43, 47, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Silverbrook and Fukuchi et al. discloses the basic elements of the claimed invention except for a page-width printhead configuration, the heater element having two opposite sides and configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element, and the heater element

substantially covered by a conformal protective coating, all sides of the coating being seamless.

Kubby teaches the printhead extending across the entire width of the sheet. Kubby teaches the heater element [20a and 20b] causing a gas bubble to be formed on both sides of the heater element [20a or 20b] in [Col. 4, Lines 59-63]. Kubby teaches a heater element [20a or 20b] that is substantially covered by a protective coating substantially to all sides, which are seamless in [Col. 4, Lines 32-50] shown in Fig. 4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the elements taught by Kubby to the printhead of Ims in view of Silverbrook and Fukuchi et al. for the purpose of placing an image on a sheet in a single pass, properly heating the ink, and protecting the heater.

20. Claim 45 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Silverbrook (US Pat. 5,856,836).

Ims in view of Silverbrook ('452) and Fukuchi et al. discloses the basic elements of the claimed invention except for the printhead configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied to heat the heater element to cause ejection of an ink drop is less than the energy required to heat a volume of an ejectable liquid equal to the volume of the ink drop, from an ambient temperature to the boiling point.

Silverbrook ('836) teaches in [Col. 4, Lines 59-65] comprising a thermally activated liquid ink printing head being characterized by the energy required to eject a drop of ink being less than the energy required to raise the temperature of the received supply of ink of a volume equal to the volume of said ink drop above the ambient ink temperature to below ejection temperature. Ejection temperature is referred to in Claim 38 as the temperature above boiling point. Therefore, "below ejection temperature" would include the boiling point.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Silverbrook ('836) with the printhead of Ims in view of Silverbrook ('452) and Fukuchi et al. for the purpose of providing a higher nozzle density per row, a manufacturing process for the printhead with low production costs, and to dissipate the full amount of the active power in the printed ink itself.

21. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Feinn et al. (US Pat. 6,543,879).

Ims in view of Silverbrook and Fukuchi et al. discloses the basic elements of the claimed invention except for a nozzle density greater than 10000 nozzles/cm^2.

Feinn et al. teaches in [Col. 2, Lines 1-14] a nozzle packing density of at least 100 nozzles/mm^2, which is equal to 10000 nozzles/cm^2 when converted to square centimeters.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the nozzle density of Feinn et al. to the printhead of Ims in view of Silverbrook and Fukuchi et al. for the purpose of accommodating higher printing resolutions and to improve the printhead drop generation rate in [Col. 1, Lines 57-61].

22. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Kashino et al. (US Pat. 5,534,898).

Ims in view of Silverbrook and Fukuchi et al. discloses the basic elements of the claimed invention except for a nozzle plate of the printhead having a thickness of less than 10 microns.

Kashino et al. teaches a thickness of an orifice plate in the order of several microns in [Col. 6, Lines 34-41].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the thickness of the Kashino et al. nozzle plate to the Ims in view of Silverbrook and Fukuchi et al. printhead for the purpose of obtaining adequate values of the velocity of the discharged ink droplets, amount of ink

droplet and refilling frequency, and in consideration of the distance between the thermal energy generating element and the discharge port.

23. Claim 48 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Keil et al. (US Pat. 6,447,104).

Ims in view of Silverbrook and Fukuchi et al. discloses the basic elements of the claimed invention except for the gas bubble collapsing to a collapse point spaced from the heater element.

Keil et al. teaches a bubble collapse occurring at a location well spaced from the heat transducer [34] in [Col. 4, Lines 48-56] shown in Figs. 3-5.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Keil et al. with the printhead of Ims in view of Silverbrook and Fukuchi et al. for the purpose of extending the life of the heat transducer [34].

24. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Komuro (US Pat. 4,965,594).

Ims in view of Silverbrook and Fukuchi et al. discloses the basic elements of the claimed invention except for a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

Komuro teaches heating resistors [11A, 21, and 31] of a first, second, and third layer formed on different respective layers and a plurality of nozzles [2] having chambers [4] with heaters [11A, 21, and 31] disposed within in [Cols. 3 and 4, Lines 25-68 and 1-34] shown in Figs. 1-4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the stated structure of Komuro with the printhead of Ims in view of Silverbrook and Fukuchi et al. for the purpose of keeping discharge speed and frequency characteristics in a stable manner.

25. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Chan (US Pat. 5,710,070).

Ims in view of Silverbrook and Fukuchi et al. disclose the basic elements of the claimed invention except for a heater element formed of solid material of which more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

Chan teaches a thermal inkjet printhead comprising a resistive layer composed of titanium nitride, which forms a resistor and a contact metal barrier layer in [Col. 2, Lines 10-14]. Titanium has an atomic number less than 50 on the periodic table.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the titanium nitride resistor to the printhead of Ims in view of Silverbrook and Fukuchi et al. for the purpose of having resistors that are more reliable, especially at higher temperatures and less complicated to manufacture.

26. Claim 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,841,452) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Pan et al. (US Pat. 4,931,813).

Ims in view of Silverbrook and Fukuchi et al. discloses the basic elements of the claimed invention except for the heater element configured to a mass of less than 10 nanograms.

Pan et al. discloses the heater element including a solid that is heated to form a bubble vapor to cause ejection of an ink drop, but does not explicitly teach the solid having a mass less than 10 nanograms. It would have been obvious at the time the invention was made to a person having ordinary skill in the art at the time the invention was made to apply at least 10 nanograms of the solid material to the heating element of Ims in view of Silverbrook and Fukuchi et al. to cause an ejection of an ink drop since it

has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ (CCPA 1980.)

Conclusion

27. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The prior art reference (US Pat. 4,870,433) cited in the PTO 892 form show elements that are deemed to be relevant to the present invention. The reference should be reviewed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Han S. Choi whose telephone number is (571) 272-8350. The examiner can normally be reached on Monday - Friday, 8:30am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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